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An Icon Preferences Study on Colors

Qing Guo
Iowa State University

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An icon preferences study on colors

by

Qing Guo

A thesis submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Human Computer Interaction

Program of Study Committee:
Sunghyun Kang, Major Professor
Seda Mckilligan
Suman Lee

Iowa State University

Ames, Iowa

2016

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ABSTRACT

Icon is one part of UX (user experience system), which determines how users feel when they use a product, and even leads to user loyalty. The use of colors is one way to improve user experience and eventually makes users to be loyalty towards a product. Therefore, the purpose of this study was to investigate users' icon color preferences, in order to assist designers creating appropriate and widely preferred icons. This study explored how colors and display polarity affected on icon preferences. The results shown that blue, green, and red icons were more preferred over yellow, orange, and purple colored icons. And negative-displayed icons were generally more preferred than positive-displayed icons.

CHAPTER 1. INTRODUCTION

Icon is one part of User Experience (UX) to express information on the surface of the whole UX system (Garrett, 2016). When users use a product, the aesthetics quality of icons, including the colors of icons, significantly affects users' emotional responses (Bloch, 1995). Good emotional responses and experiences can attract new users and improve user loyalty. A study also approved this point as: icon colors significantly affect users subjective preferences for a digital screen interface. The researchers found that use of colors is one of the ways to improve user experience (Shieh, Chen, & Chuang, 1997).

Being part of the surface plane of UX, aesthetics related visual elements are important to a product, since users aesthetics preferences influence their emotional experiences when they use a product, which will eventually determine whether they feel good or not with this product (Gatto, 1987). To be more clear, the aesthetics quality of a product affects users emotional experience and might determine whether this user will built loyalty relationship with this product or not. And according to Norman, aesthetically pleasing design can influence users preferences towards a product (Norman, 2004). Therefore, understanding users aesthetics preferences is essential for designer to generate products.

Another factor affecting icon preferences is display polarity (Ko, Shen & Lee, 2010). Positive-display-polarity refers to the image that has lighter character color and darker background color; negative-display-polarity means the image that has darker character color and lighter background color (Dillon, 1992). Some researcher found negative-display-polarity images (light character on dark background) could reduce users sensitivity to screen flicker (Mills & Weldon, 1987).

Preferences affect users loyalty. Users tend to spend more time with the products that make them feel good (Gorp & Adams, 2012). Therefore it's important to figure out users' icon color preferences.

CHAPTER 2. LITERATURE REVIEW

2.1 UI and UX

2.1.1 UI vs. UX

UI are the two first letters of user interface, which connecting users to products. User interface is the “externals” that users directly see, hear, smell, touch, or feel during using a product (Mckay, 2013). UX, refers to user experience, is a compress of entire experiences and feelings including both “internals” and “externals” (McKay, 2013). Take a smartphone as an example, for the user interface (“externals”) includes appearance, color, screen interface design, icon design, etc; for the user experience (“externals and internals”), except the user interface part, it also includes operating system, product branding, purchasing experience and so on. Therefore, UI is the communication between users and the internal functions of a product.

In order to support an appropriate communications between users and products, UI could not be only subjective esthetic oriented, but instead, UI should be objectively communicative to assist users to use the products (Mckay, 2013). In anther word, the main function of UI is assisting users to understand how to operate a product effectively.

On the contract, user experience is personal, emotional, and subjective (Garrett, 2016).

2.1.2 Elements of UX

Garrett created a set of five planes to develop user experience, he arranged them from concrete to abstract: “surface”, “skeleton”, “structure”, “scope”, and “strategy” (Garrett, 2016 p36).

Surface (sensory design) is external information users getting from using a product, which includes visual, auditory, and tactile aspects. For example, color of a product, background music,

surface texture, and so on. Surface plane is sensory design, which is the first thing come to users. It includes colors, typography, sounds, and tactile qualities, etc (Garrett, 2016).

Skeleton (interface design) is the arrangement of all design elements mentioned in the previous plane—the placement of buttons, images, or logos (Garrett, 2016). Icon is part of interface design in UX, which express information to users effectively. Therefore icon can affect users perception, decision, and overall experience (Horton, 1994).

Structure (interaction design) is the relationships between the internal functions and the external information of a product; it deals with how to make all various functions of this product fit well together. Take the information architecture of a smartphone interface as an example on this point, the structure would define how users could go to setting section to set their phones, or how users could go back to home page after they finish the tasks in setting section (Garrett, 2016).

Scope (functions) controls the functions of a product. The most abstract plane is the strategy plane (product objectives), which is aiming to find out the direction and market needs of this product (Garrett, 2003).

2.1.3 User Loyalty and UX

Experience is emotional (Garrett, 2016). Positive experience makes users be more likely to spend more time with a product. Therefore, a good experience leads user loyalty (Garrett, 2016). For instant, in smartphone interface design, an appropriate and easy information architecture makes users feel comfortable to find the content they want and fulfill the tasks. As a result, the emotional connections between users and this product are positive and satisfied. And users are known to be more likely to send more time with the products that make they feel good (Garrett,

2016). A study conducted in Toronto also had the similar findings: the researcher claimed that users good experience is one vehicle for affecting user loyalty. And user loyalty is one of the measurements to evaluate the probability of users repeating and continuing using one product (Lmaz, Shalaby, Habib, Idris, 2014).

2.2 Why Emotional Experience Matters

2.2.1 Emotional needs

Sanders classified three directions of designing a product: “Useful”, “Usable”, and “Desirable”. It is easy to understand that a product should to be useful and usable, since one product’s most important need is to be functional and accessible. Desirable is providing pleasure for users, which is about emotional feelings (Sanders, 1992). Among these three parts, functionality is the basic requirement for a product (Geel, 2001). When functionality is norm for product, aesthetics take on greater importance, which is true for both physical and digital products, like smartphone interfaces (Gorp, Adams, 2012). For example, improving aesthetics is one way to satisfy users’ emotional pleasure (Gorp, Adams, 2012). Human nature is to build relationships with the things that make us feel good, and everything sends out emotional signals (Donald Norman).

2.2.2 Reasons to Design for Emotion

In Gorp and Adam’s book (2004), they listed five reasons to design for emotion:

- “1. Emotion is experience”
- “2. All design is emotional design”
- “3. Emotion dominates decision making”

“4. Emotion commands attention and affects memory”

“5. Emotion communicates personality, forms relationships, and creates meaning”

“ Emotion is Experience”

Emotions influence the interactions and experiences that users have with brands and products (Forlizzi & Battarbee, 2004). The emotional feedback users have during using a product is experience. For instant, when a user uses a smartphone interface, he or she feels emotional pleasure, which means “good” experience. And according to previous literature reviews, users tend to spend time with the products that make them feel good.

“ All Design is Emotional Design”

Imagine that a user is choosing between two similar products with same functions, he or she needs to make a decision of which one to use. The reason why he or she can make decision between these two similar products is that this user has emotional responses to feel which one is better. Damasio explained people can not make even simple cognitive decisions without emotional responses (Damasio, 1994). Therefore, to make a product successful, users’ emotional responses should be taken into consideration. In another word, “all design is emotional design”.

“ Emotion Dominates Decision Making”

As mentioned in last paragraph, emotional responses influence cognitive decisions. What’s more, emotions can even dominate decision making, rather than only influence it. The reason is that the more intense our emotional experience is, the lower ability we will have to evaluate the

pros and cons of a product (Gorp & Adams, 2012). For example, if a user has a strong emotional connection with a brand, he or she will be more willing to choose the product of this brand than from other brands.

“Emotion Commands Attention and Affects Memory”

Some researchers claimed that “negative emotion experiences hold much more psychological weight than that of positive emotional experiences”, which will lead to stronger and longer memories of negative feelings. Therefore, if a user had a bad feeling with a product, he or she will be very likely to not choose this product or brand for a long time. For designer, for example, if we design a smartphone interface, emotional design is to create emotional responses for users. These emotional responses will form the user experiences.

2.3 Aesthetics, UX, and User Loyalty

How a product looks can attract users, and attraction is the beginning of relationship between users and products, which can turn out to be user loyalty ((Gorp & Adams, 2012). Without a good-looking appearance, or a pleasing emotional attraction, the very first step to form user-product relationship could not happen. Therefore, aesthetics should be in consideration to build user loyalty. As mentioned before, if there are two similar products with exactly same functions, the one with a more pleasing appearance gives this user a better emotional connection and response, which will lead the user to choose this product.

Gatto stated that aesthetics are the sense of feeling what is visually pleasing (Gatto, 1987). Human can feel what kind of visual appearances are emotionally pleasing for themselves. To be part of the surface plane of UX, aesthetics related visual elements are important to a product,

since users aesthetics preferences influence their emotional experiences when they use a product, which will eventually determine whether they feel good or not with this product. To be more clearly, the aesthetics quality of a product affects users emotional experience and might determine whether this user will built loyalty relationships with this product or not. Therefore, understanding users aesthetics preferences is essential for designer to generate products (Bloch, 1995). Norman also mentioned the similar statement that “aesthetically pleasing design can be influential in affecting users preferences” (Norman, 2014). A study approved this point that icon colors significantly affect users subjective preferences for a digital screen interface. The researchers found that use of colors is one of the ways to improve user experience (Shieh, Chen, & Chuang, 1997). On the contrary, inappropriate use of color will result bad visual experiences (Shieh, Chen, & Chuang, 1997). According these previous literatures, visual elements, like color, influence users choices of a screen interface (Shih-Miao Huang, 2012).

2.4 Icon Colors

Color is a communication driver. In icons, color can communicate (Horton, 1994). Color can make message clear, and even make important information to be out standing (Horton, 1994).

2.4.1 icon colors’ functions

In the study “an icon recognition study on different simplicity levels”, the researcher created the icons as black and white. And the most of the participants could recognize the icons correctly (Guo, 2016). If black and white icons can express information effectively and correctly, why we have to introduce colors into icons? Horton stated that colored icons help users find information quicker (Horton, 1994). He also listed the most important functions that colors have:

“To direct attention”

Color can catch and direct user's attention to a certain icon, and the specific detail on an icon, which is especially true for small sizes icons. Since color can make smaller items stand out (Horton, 1994). If an icon's color is bright, pure, saturated, and high-contrast with background color, it is emphasized.

“To speed search”

Color can assist users to find a target information quickly in a complex and clutter display environment, since a research approved that “color coding is more effective” to make a target more out standing than other techniques, like shape coding (Horton, 1994).

“To aid recognition”

Color is a communication tool (Horton, 1994), therefore color carries information. The icons carrying expected, familiar colors are much easier and more quickly to be recognized than black and white icons (Horton, 1994). For some cases, even though the most accepted and the most widely used colors are not realistic, they can still simulate icon recognition. For example, the red color for stop sign on road.

“To show organization”

Colors can group items (Horton, 1994). Imagine that, there are countless leaves and small flowers on a tree, but we can figure out which ones are leaves, and which ones are flowers. Since leaves' green and flowers' red group them separately, we can distinguish them by only one glance.

“To attract and please users”

Users color preferences are personal and subjective (Horton, 1994), but using a widely preferred color combination will make most people feel comfortable and pleasing. Horton claimed that “western adults prefer colors in order of: blue, red, green, purple, orange, and yellow” (Horton, 1994).

“To reinforce or arouse an emotion”

Color has ability to arouse human emotions, which is approved by several studies. Some documents shows that color has influences on blood pressure, muscle strength, brain-wave activity, and electrical condition of skin ((Horton, 1994).

Except the functions that colors have to assist icon functions to express information, icon color also makes contribution to improving UX, since color combination significantly influences users preferences towards icon design (Pastoor, 1990).

2.4.2 Positive-display-polarity and Negative-display-polarity

Another factor affecting icon preferences is display polarity (Ko & Shen, 2010). In Ko and Shen's study (2010), display polarity had a statistically significant relationship with icon preferences. Positive-display-polarity refers to the image that has lighter character color and darker background color; negative-display-polarity means the image that has darker character color and lighter background color (Dillon, 1992).

Some researcher found negative-display-image (light character on dark background) could reduce users sensitivity to screen flicker (Mills & Weldon, 1987). The negative polarity was more preferred than the positive polarity (Ko, Shen & Lee, 2010). Therefore, the researcher generated both positive and negative polarity icons to test whether users prefer positive or negative displayed icons.

CHAPTER 3. METHODOLOGY

3.1 Study Questions and Hypothesis

Study Questions and hypothesis:

1. How users prefer icon colors?
2. Will users prefer positive-display-polarity or negative-display-polarity?
3. How color preferences of individuals affect users' icon color preferences?

The study was an online icon preferences study, which included two survey parts. Part 1 focused on positive-display-polarity icons, and Part 2 focused on negative-display-polarity icons, respectively. The survey questions were designed to figure out participants' icon color preferences based on the three study questions. According to some previous study, the influence of polarity on icon preferences was significant. The negative polarity was more preferred than the positive polarity (Ko, Shen & Lee, 2010). And Chongourian (1969) found "a general preference for the color blue". Horton claimed that "western adults prefer colors in order of: blue, red, green, purple, orange, and yellow" (Horton, 1994. P170). Therefore, the hypothesis of this study was that participants would prefer negative-display-polarity icons, and would prefer blue, red, and green icons.

3.2 Methodology Introduction

The object of this study was to investigate how users prefer icon colors; will users prefer positive-display-polarity or negative-display-polarity, and how color preferences of individuals affect users' icon color preferences. The results could be used to assist UI designers to design widely acceptable icons with appropriate colors.

In this study, two online surveys were conducted at Iowa State University. Participants in positive polarity group completed Survey A, which focused on positive-display-polarity icons; and participants in negative polarity group completed Survey B, which focused on negative-display-polarity icons. survey Part A focused on positive-display-polarity icon color preferences, and survey Part B focused on negative-display-polarity icon color preferences. There were three main sections in both survey Part A and Part B: Section 1 (Question 1 to Question 5) was focused on users' icon color preferences; Section 2 (Question 6 to Question 10) was aiming at users' preferences for positive display polarity, and negative display polarity; Section 3 (Question 11) was to examine users' individual color preferences.

Since the main measure was to perceive the relationship between icon colors and user preferences, for Section 1 (Question 1 to Question 5), survey Part A and Part B shared the same stems, but contained positive-display-polarity icons and negative-display-polarity icons, respectively. Participants in both groups were shown each function's icon with six different colors in each question. They were asked to rank their preferences for icons with each color.

For Section 2 (Question 6 to Question 10), Survey A and Survey B shared exactly same questions. After seeing positive-display-polarity and negative-display-polarity icons respectively, participants in both groups saw the same questions in this section. Each question focused on one function's icon. In each question, there were two styles of icons, one was positive-display-polarity icons with six colors, and the other one was negative-display-polarity icons with six colors. Participants were asked to choose which style they preferred.

After they chose the preferred style, they were brought to Part 3 (Question 11). In question 11, participants were asked to rank their color preferences, in order to examine whether individual color preferences affect icon color preferences.

There were two reasons that the researcher separated participants in to positive polarity and negative polarity groups to rank their icon color preferences respectively during the icon color preferences questions. The first reason was that the researcher would get the results showing whether display polarity affects icon color preferences or not. Additionally, since participants in each group chose their preferred display polarity styles after seeing either positive or negative displayed icons; the results would show that whether familiarity would affect participants' preferences towards polarity display styles or not.

This chapter will describe how the study materials were created, how participants were recruited, and how this study was designed.

3.3 Study Materials

To conduct this study, the researcher generated 60 icons using six colors: red, yellow, blue, yellow-red (orange), green, and purple. The icons were created based on five extremely simplified black-and-white “phone call,” “message,” “email,” “camera,” and “browser” icons, which are recognizable enough (Guo, 2016).

3.3.1 Icon modification

As shown in Figure 3.1, all the five icons designed in the study “an icon recognition study about different simplicity levels” were highly recognizable, exempt the “phone call” icon, whose correct recognition rate was 6.2%. In order to make this icon more acceptable for users, researcher modified it by changing the object shown in this icon into a more familiar object to users—an old style phone (Figure 3.2).

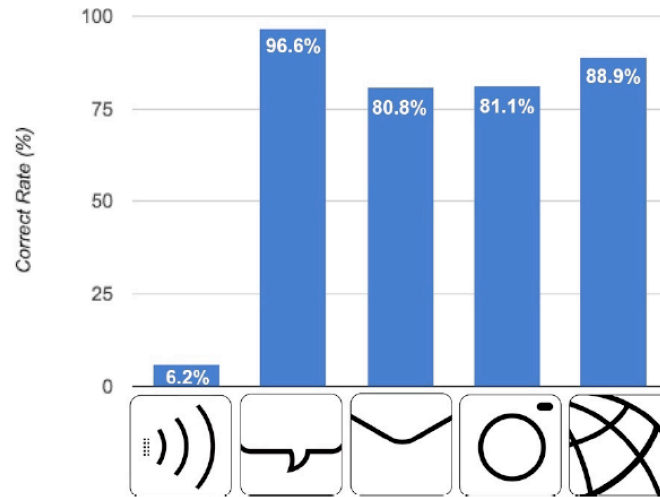


Figure 3.1 Five icons' correct recognition rates

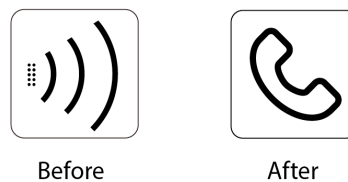


Figure 3.2 “Phone Call” icon modification

3.3.2 Adding Colors

Color selection:

According to a study by Huang and Chiu, when the icons have red, yellow, or blue as the main color, subjects' visual performance was better than that of other colors (Huang, Chiu, 2017). Therefore, the researcher decided to include these three colors. In Munsell Color Order System, red (5R), yellow (5Y), and blue (5B) were listed. As shown in Figure 3.3 the Munsell Color System classified colors into ten main hues: red, yellow-red, yellow, green-yellow, green, blue-green, blue, purple-blue, purple, and red-purple (Munsell, 1992).

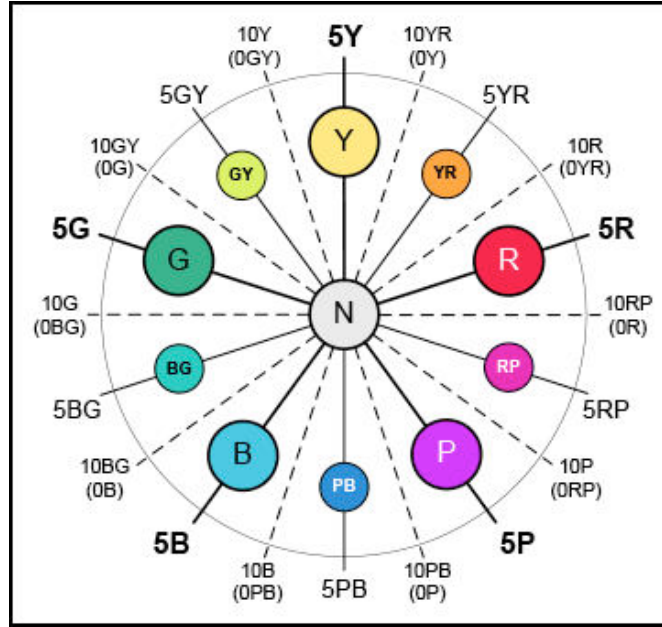


Figure 3.3 *Munsell Color System (Munsell, 1992)*

Among all these ten colors, this study consisted of the previous mentioned three colors, red, yellow, blue, and their approximate angle bisectors (yellow-red, purple, and green) from Munsell Color System. Therefore, red, red-yellow, yellow, green, blue, and purple were selected for this study.

The Munsell Color System applies to surface colors, like printed colors; but this study was conducted through online survey, and all the icons were displayed on digital screens, where RGB system applies (Centore, 2013). Therefore, all the six colors selected from Munsell Color System were converted to RGB values. According to Centore's "Munsell to RGB Conversions" (Centore, 2013), the researcher had the six RGB colors as: red (255, 68, 85), yellow-red (255, 174, 43), yellow (255, 229, 29), green (67, 228, 166), blue (80, 219, 249), purple (156, 26, 193). (Figure 3.4)



Figure 3.4 color selection

3.3.3 Positive-display-polarity Vs. Negative-display-polarity

According to previous literature review, positive-display-polarity refers to the image that has lighter character color and darker background color; negative-display-polarity means the image that has darker character color and lighter background color (Dillon, 1992).

Some researcher found negative-display-image (light character on dark background) could reduce users sensitivity to screen flicker (Mills & Weldon, 1987). Therefore, the researcher generated both positive and negative polarity icons to test whether users prefer positive or negative displayed icons. As shown in Figure 3.5, 60 icons in total were created for this study.

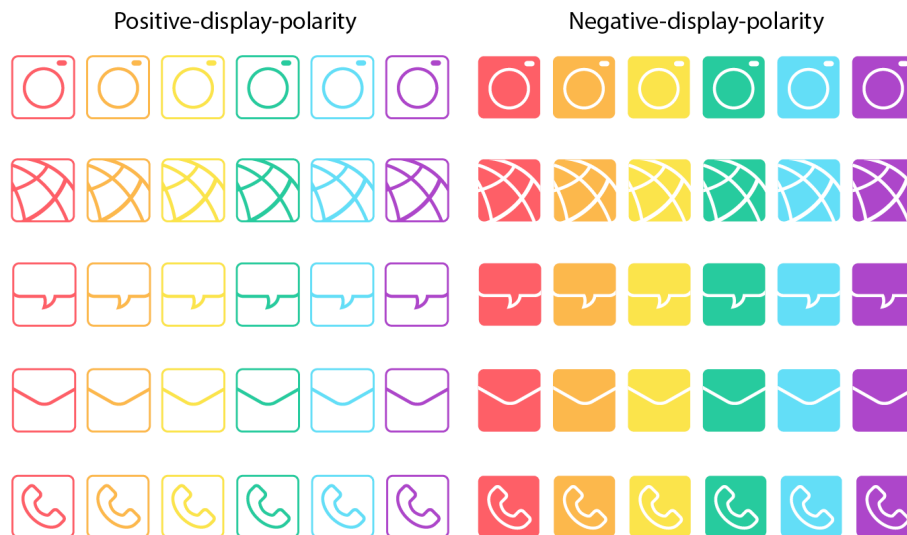


Figure 3.5. All icons designed for this study

3.4 Study Participants

Before conducting this study, mass email list of all currently enrolled students at Iowa State University requested from the Registrar's office was equally and randomly divided into two groups, and labeled as "positive polarity group," and "negative polarity group". There was no overlapping participant between these two groups. Participants in positive polarity group only received survey Part1 recruiting email, and participants in negative polarity group only received survey Part 2 recruiting email. 1071 participants participated in survey Part 1, among them, 898 completed the entire Part1. 1036 participants joined in Part 2, and 920 of them completed the entire Part 2 questions. When participants entered both two survey parts, they were asked to report personal information, including age ranges, genders, education backgrounds, and first languages.

3.5 Study Design

There were two survey parts in this study. Positive polarity group participated in survey Part 1 (SEE APPENDIX D), Negative polarity group participated in survey Part 2 (SEE APPENDIX E). These two parts were conducted at the same time. They were two paralleled and independent surveys. Part 1 focused on positive-display-polarity icons, and Part 2 focused on negative-display-polarity icons. Two parts shared the same stems, and same question designs. There were three main sections in both Part 1 and Part 2.

3.5.1 Section 1: Icon color preferences

Question 1 to Question 5 in both two parts shared the same stems, but included two different styled icons (SEE APPENDIX D & E). As shown in Figure 3.6, in Part 1, Question 1 to Question 5 (Section 1) listed six colored positive-display-polarity icons for each smartphone function in each question. Participants were asked to rank their icon color preferences from 1 to 6—1 stood for the most preferred and 6 stood for the least preferred. In Part 2, as shown in Figure 3.7, Question 1 to Question 5 (Section 1) listed six colored negative-display-polarity icons for each smartphone function in each question. Participants were also asked to rank their icon color preferences.

It is worth mentioning that participants were informed the icons were for smartphone interfaces, since visual elements are embedded with the context (Semiotic-advertising). And participants only saw one question at one time, therefore they would not be interrupted or affected by other icons in other questions.

3.5.2 Section 2: Preferences to positive and negative-display-polarity icons

Section 2 including Question 6 to Question 10 were aiming to test whether participants preferred positive-display-polarity or negative-display-polarity icons. Question 6 to Question 10 in both two parts were exactly the same (SEE APPENDIX D & E). Participants in positive polarity group and negative polarity group saw exactly same questions in this section. As indicated in Figure 3.8, no matter which display styled icons the participants saw in Section 1 questions, they were shown both two display styled icons in Question 6 to Question 10 and were asked to choose which one they preferred in each question.

Q1/Q11. Drag and drop to rank. Please rank each icon **color's APPROPRIATENESS** for the "Camera" icon on smartphone interfaces.
(Most appropriate COLOR at the top)




Figure 3.6. Selected example shows Question 1 to Question 5 in Part 1. One webpage only displayed one question individually.

Q1/Q11. Drag and drop to rank. Please rank each icon **color's APPROPRIATENESS** for the "Camera" icon on smartphone interfaces.
(Most appropriate COLOR at the top)





Figure3.7. Selected example shows Question 1 to Question 5 in Part 2. One webpage only displayed one question individually.

Q7/Q11. Please select which of the following icon **STYLES** do you **prefer** for "Message" icon?



The image shows a survey question interface. At the top, it says "Q7/Q11. Please select which of the following icon **STYLES** do you **prefer** for "Message" icon?". Below this, there are two rows of six message icon styles each. The top row consists of solid-colored icons: red, orange, yellow, green, blue, and purple. The bottom row consists of outlined icons of the same colors. A red button with ">>" is located at the bottom right of the interface.

Figure 3.8. Selected example shows Question 6 to Question 10 in both Part 1 and Part 2. One webpage only displayed one question individually.


3.5.3 Section 3: Individual color preferences

Aiming to test whether individual color preferences affected icon color preferences or not, individual color preferences results were collected in this section. Question 11 in both two parts were exactly the same (SEE APPENDIX D & E). Participants in positive polarity group and negative polarity group saw exactly same question in this section. For Question 11 in both parts, participants were shown six pure color dots and asked to rank individual color preferences (Figure 3.9).

3.6 Study Tool

This online surveys were created and conducted on Qualtrics, which is a website for creating online surveys, recording participants' information, and downloading all surveys record data. After downloaded from Qualtrics, all data was analyzed and calculated in SPSS.

Q11/Q11. Drag and drop to rank. Please rank your **COLOR PREFERENCES**.
 (Most preferred COLOR at the top)



>>

Figure 3.9, *Question 10 in both Part 1 and Part 2. One webpage only displayed one question individually.*

3.7 Study Procedure

The very first step the participants did was to read the informed consent (See APPENDIX B), which informed participants that they could quit this survey at anytime without any punishment. During reading this informed consent, they were also introduced the purpose, question types, benefits, risks, and confidentiality of this study. Participants decided whether they would like to take party in this study or not entirely voluntary.

The participants who disagreed the informed consent would automatically quit the survey, and the ones who agreed to join were automatically brought to the survey questions. Before answering the survey questions, all participants were asked to answer a demographic entrance

survey about their personal backgrounds. They had already informed that all their personal information would be protected in the informed consent.

Participants in positive polarity group and negative polarity group completed survey Part 1 and Part 2 at the same time independently. They answered 11 questions in each part, respectively. Question 1 to Question 5 in each part shared same stems, but different icons. And they were shown same Question 6 to Question 11 in each part, respectively. At last, data of Part 1 and Part2 were downloaded from Qualtrics to the researcher's computer, in order to calculate and analyze to answer the study questions.

CHAPTER 4. DATA ANALYSIS AND RESULTS

This Chapter shows the data analysis results aiming to answer the three study questions:

1. How users prefer icon colors?.
2. Will users prefer positive-display-polarity or negative-display-polarity?
3. How color preferences of individuals affect users' icon color preferences?

4.1 Preparing Data

The data of this study was all the information from both survey Part 1 and Part 2. All the information was downloaded as IBM Social Sciences (SPSS) format into the researcher's computer from Qualtrics. In SPSS, One-way analysis of variance (ANOVA) tests were conducted to test the significances. A significance level of $p \leq .05$ was used for all ANOVA analyses.

4.2 Data Analysis

Since Part 1 and Part 2 were two independent surveys, the data of these two parts were analyzed separately. Part 1 focused on positive-display-polarity icons, and Part 2 focused on negative-display-polarity icons. In order to compare how icon color preferences vary between positive-display-polarity and negative-display-polarity icons, the data of these two parts would be compared.

4.2.1 Part 1

4.2.1.1 Part 1 data cleaning

In Part 1, 1071 participants agreed to join this survey. Among them, 11 participants did not answer any question of this survey; 51 participants quit after finishing the demographic questions; and 111 participants quit during Question 7. As a result, 898 participants completed the whole survey Part 1, and these 898 participants' data were used and analyzed.

4.2.1.2 Part 1 participants' demographic

All the participants for Part 1 were Iowa State University students (49.81% male students and 49.72% female students). The participants were composed of 85.38% undergraduate students and 14.62% graduate students. Nearly 90% of their age ranged from 18 to 24 years old, and about 9% were 25 to 34 years old. Among all the participants in positive polarity group, 88.74% were native English speaker.

4.2.1.3 Part 1 results

a. Section 1: Icon color preferences

There were three sections in Part 1: Section 1 included Question 1 to Question 5. Each question focused on one smartphone function, and in each question, participants were asked to rank their preferences towards six different icon colors. According to the Qualtrics' record, researcher got participants' self-reported icon color preferences ranking results. As shown in Figure.4.1, the bar charts indicating how participants ranked six colors' appropriateness for each icon: 1 stood for the most appropriate, 6 stood for the least appropriate. For "Camera" icon, it is obvious (Figure 4.1 a) that participants tended to regard blue and green































colors as the more appropriate color for the meaning of camera; orange and yellow colors as the less appropriate. For “Email” icon’s color, participants also ranked orange and yellow as the less appropriate colors. What is noticeable is that participants ranked red color as the most appropriate color, followed by the green color. For “Browser” icon, blue and green color were ranked as the more appropriate colors again. Orange was still regarded as not appropriate enough for this icon. Purple was ranked as the least appropriate in this question. For “Message”, the results were very similar as that of “camera” icon: blue and green colors were regarded as the more appropriate colors, and yellow and orange were regarded as the less appropriate colors. For the last one, the “Phone Call” icon, green and red colors were relatively more preferred. Orange and purple were reported to be relatively less preferred.



Figure 4.1. Results of Question 1 to Question 5 in Part 1. 1 stood for the most appropriate, 6 stood for the least appropriate.

More specifically, as shown in Table 4.1, the researcher calculated each icon color's mean value in SPSS to indicate the rating results: green icon were generally the most preferred ones (Mean=2.720), followed by blue icons (Mean=2.744); yellow icons with the highest mean value, which indicated the least preferred.

Table 4.1 Mean values of each positive displayed icon color

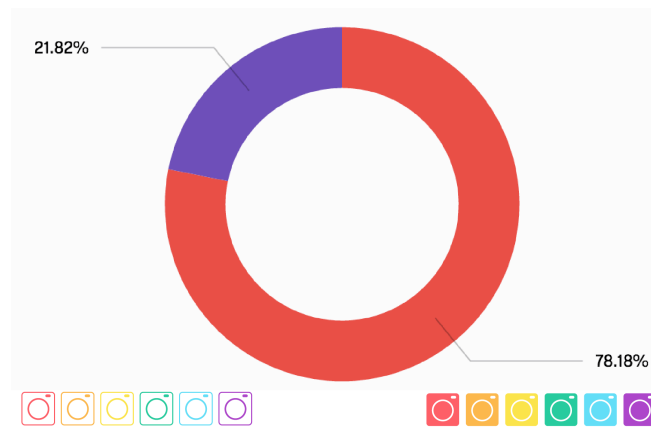
						
						
						
						
						
Mean	2.720	2.744	3.354	3.790	3.824	4.576

In conclusion, it is not difficult to figure out that, green, blue, and red were more preferred by the participants in positive polarity group, comparing with the other three colors. On the contrary, orange, yellow, and purple were ranked as relatively not preferred, in terms of these five smartphone functions.

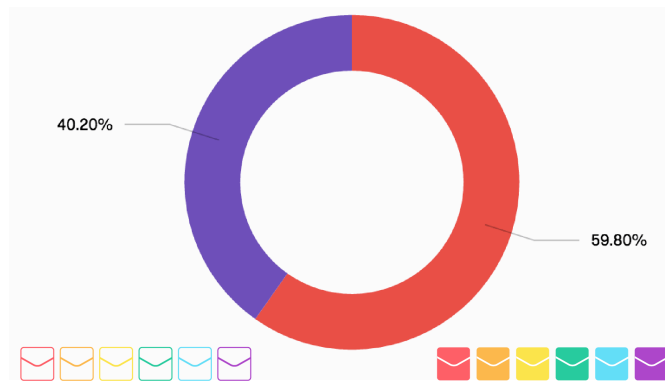
b. Section 2: preferences to positive and negative-display-polarity icons

Section 2 included Question 6 to Question 10, which were aiming to figure out whether participants prefer positive-display-polarity or negative-display-polarity icons. In this section, each question focused on one smartphone function. Each question displayed both positive and negative-display-polarity icons, in order to let participants to choose which style they preferred.

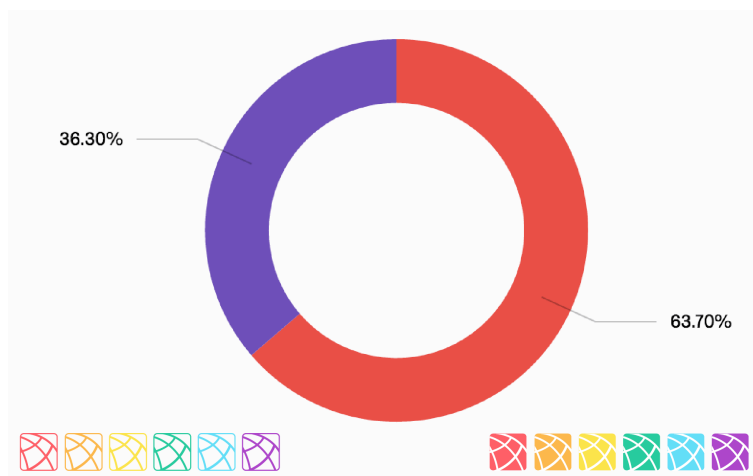
As shown in Figure 4.2 ((a)—(d)), more participants preferred negative-display-polarity icons than those who preferred positive ones, in terms of all these five smartphone icons. Especially for “Camera” icon, nearly 80% participants reported themselves preferring negative-display-polarity styled icons. For both “Browser” and “Phone Call” icons, more than 60% participants preferred the negative-display-polarity icon. Over 50% participants preferred negative-display icons, when they saw both “Email” and “Message” icons. Therefore, in a word, it is clear enough that relatively more participants preferred negative-display-polarity icon during this survey.



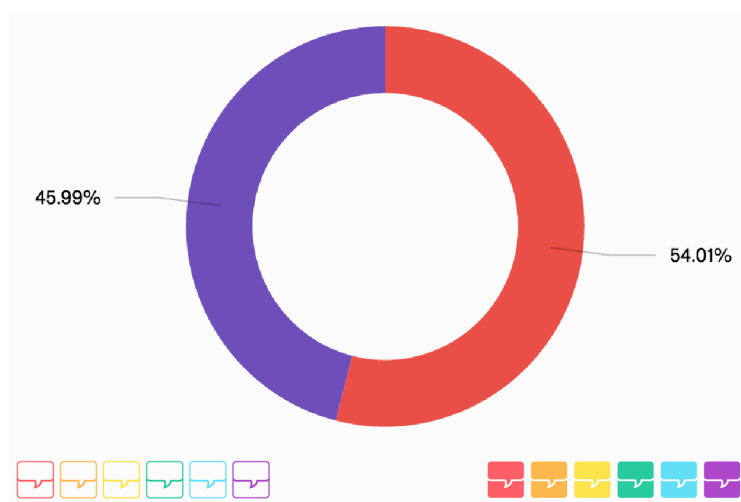
(a) “Camera” icon (Purple—positive-display-polarity; Red—negative-display-polarity)



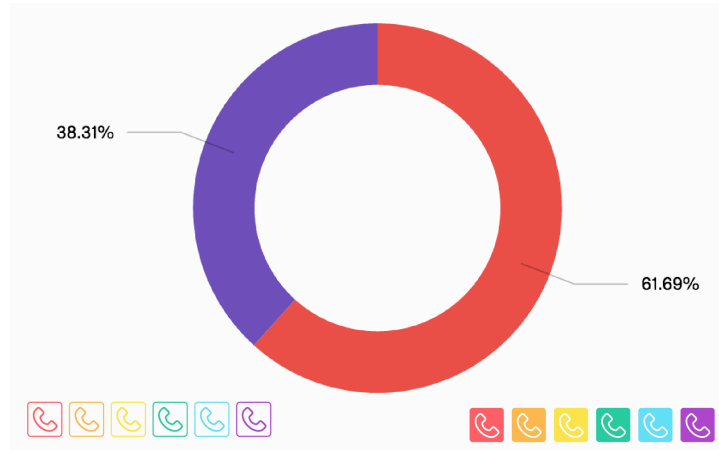
(b) “Email” icon (Purple—positive-display-polarity; Red—negative-display-polarity)



(c) "Browser" icon (Purple—positive-display-polarity; Red—negative-display-polarity)



(d) "Message" icon (Purple—positive-display-polarity; Red—negative-display-polarity)



(e) “Phone Call” icon (Purple—positive-display-polarity; Red—negative-display-polarity)
Figure 4.2, the results of the percentages of participants preferred each icon style.

c. Section 3: Individual color preferences

Similar like the results of Section 1, blue and green colors were relatively the more preferred, and yellow and orange colors were relatively the less preferred. (Figure 4.3)

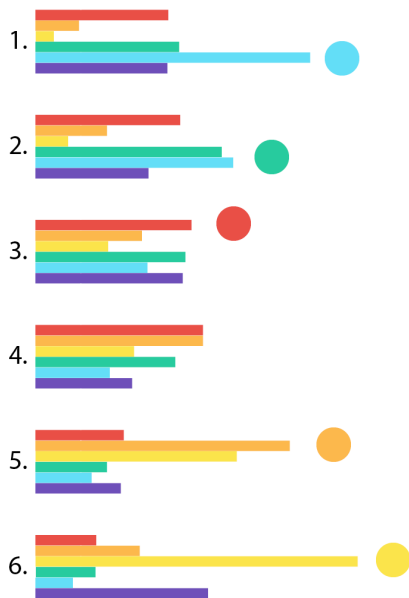


Figure 4.3. Individual color preferences ranking results in survey Part 1

4.2.2 Part 2

4.2.2.1 Part 2 data cleaning

1036 participants entered survey Part2. Among them, 34 participants only answered demographic questions, 82 participants quit during Question 1 to Question 9. In order to maintain the data validity, the researcher removed the data of the participants who quit the survey before finishing it. Therefore 920 participants' data were analyzed to answer the study questions.

4.2.2.2 Part 2 participants' demographic

These 920 participants were composed of 43.3% male and 55.26 female students. Around 90% of them were aging from 18 to 24 years old; less than 9% were form 25 to 34 years old; about 1.5% were older than 35 years old. 87.56% of them were undergraduate students, and 12.44% of them were graduate students. Among all the participants, about 92% participants were native English speakers.

4.2.2.3 Part 2 results

a. Section 1: Icon color preferences

All the stems in survey Pat 2 were exactly same as that in Part 1. There were still three sections in Part 2: Section 1 included Question 1 to Question 5. Each question focused on one smartphone function, and in each question, participants were asked to rank their preferences towards six different icon colors. As shown in Figure.000, the bar charts indicating how participants ranked six colors' appropriateness for each icon: 1 stood for the most appropriate, 6 stood for the least appropriate. Same with the positive-display-polarity icons, for "Camera" icon,































participants tended to ranked blue and green colors as the more appropriate for the meaning of camera; orange and yellow colors as the less appropriate. For “Email” icon’s color, participants also ranked green and purple as the less appropriate colors, blue and yellow color as the most appropriate color. For “Browser” icon, blue and green color were ranked as the more appropriate colors again. Red and purple were ranked as the less appropriate in this question. For “Message”, the results were very similar as that of “camera” icon: blue and green colors were regarded as the more appropriate colors, and yellow and orange were regarded as the less appropriate colors. For the “Phone Call” icon, blue and green colors were relatively more preferred. Orange and purple were reported to be relatively less preferred (Figure 4.4).



Figure 4.4. Results of Question 1 to Question 5 in Part 2. 1 stood for the most appropriate, 6 stood for the least appropriate.

In conclusion, Similar like the results of Part 1, blue (Mean=2.642), green, and red were generally more preferred by the participants in negative polarity group. On the contrary, orange, yellow, and purple (Mean=4.170) were relatively not preferred (Table 4.2).

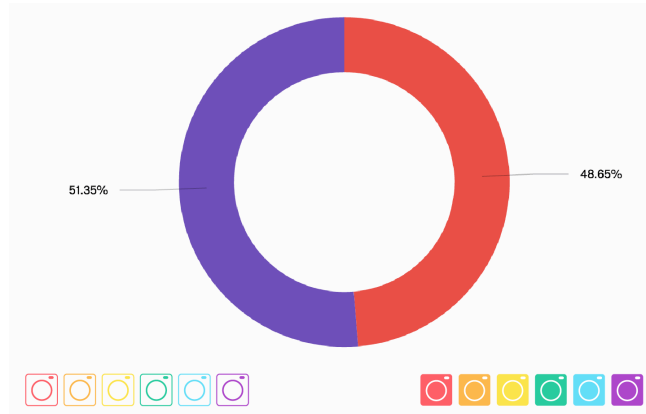
Table 4.2 Mean values of each positive displayed icon color

						
						
						
						
						
Mean	2.642	2.812	3.556	3.700	4.122	4.170

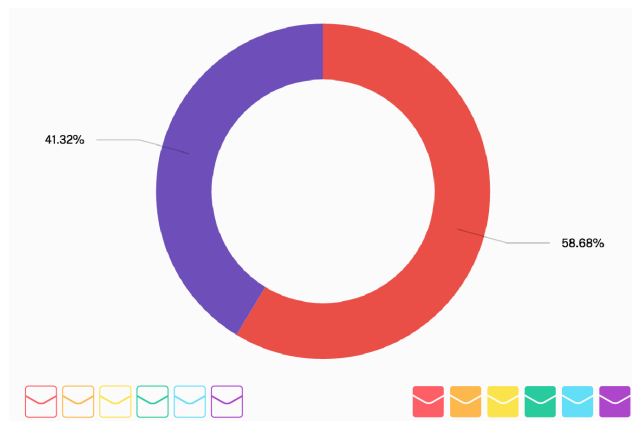
b. Section 2: Preferences to positive and negative-display-polarity icons

The same as survey Part 1, Section 2 included Question 6 to Question 10. In each question, participants were shown both positive-display-polarity and negative-display-polarity icons. And they were asked to choose which one style they preferred.

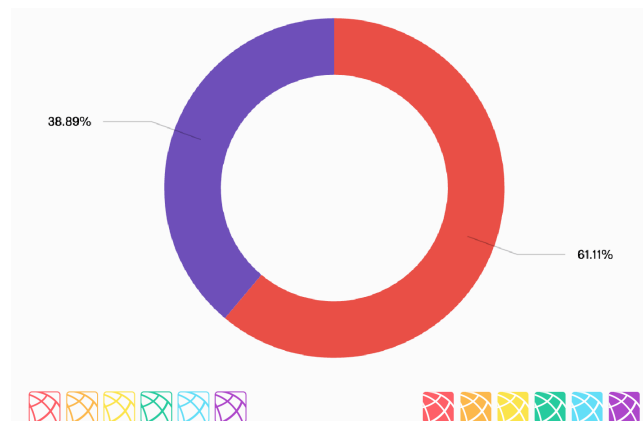
As shown in Figure 4.5 ((a)—(d)), except in Question 1, the “Camera” icons, more participants preferred negative-display-polarity icons for the other four functions icons. In Question 1, 51.35% participants claimed that they preferred the positive-display-polarity “Camera” icons. In terms of the other four questions, for each question, over 60% participants preferred negative-display-polarity icons.



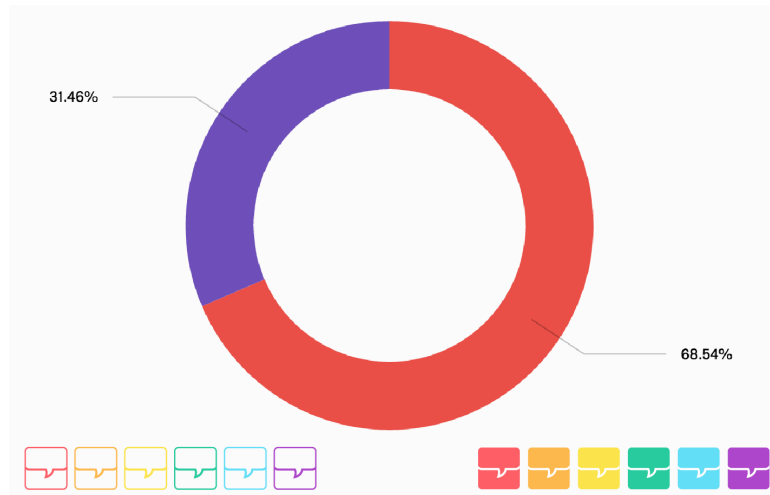
(a) “Camera” icon (Purple—positive-display-polarity; Red—negative-display-polarity)



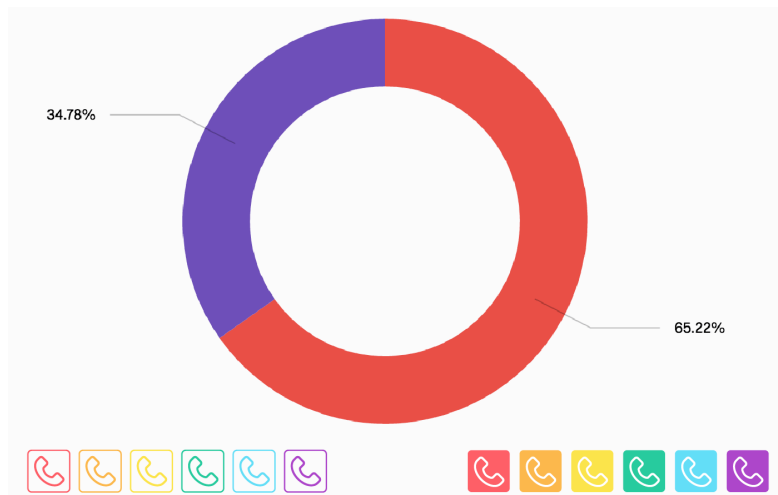
(b) “Email” icon (Purple—positive-display-polarity; Red—negative-display-polarity)



(c) “Browser” icon (Purple—positive-display-polarity; Red—negative-display-polarity)



(d) "Message" icon (Purple—positive-display-polarity; Red—negative-display-polarity)



(e) "Phone Call" icon (Purple—positive-display-polarity; Red—negative-display-polarity)

Figure 4.5, the results of the percentages of participants preferred each icon style.

c. Section 3: Individual color preferences

Very similar like the results of Part 1, blue and green were relatively the more preferred, and yellow and orange were relatively the less preferred. (Figure 4.6)

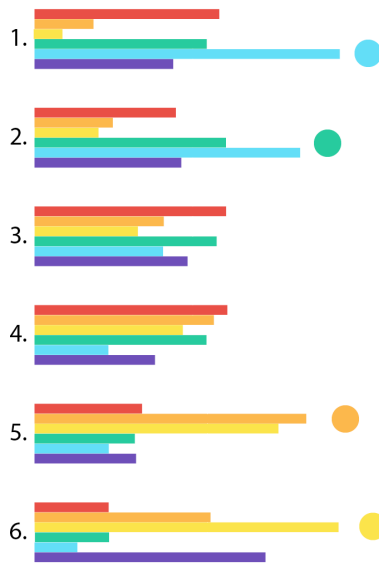


Figure 4.6 Individual color preferences ranking results in survey Part 2

4.2.3 Comparison of Positive-display-polarity and Negative-display-polarity icons

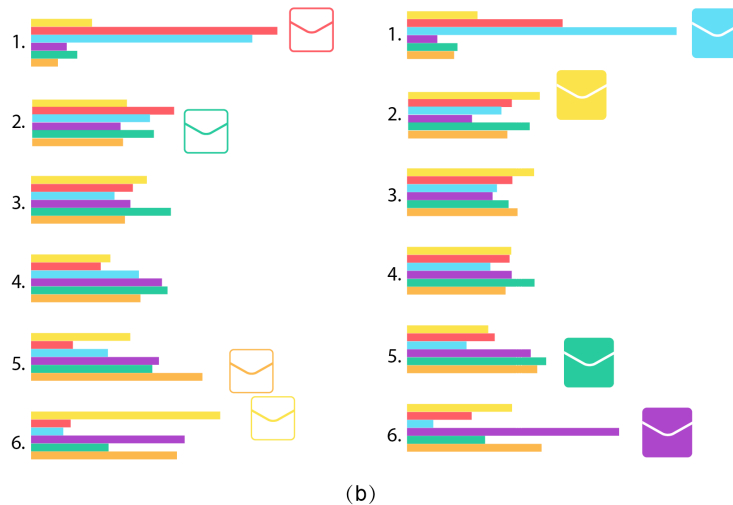
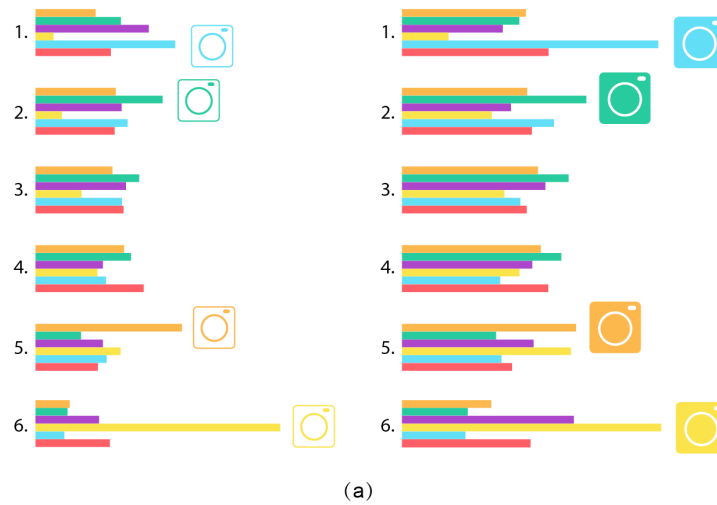
a. Section 1: Icon color preferences

Participants in positive polarity group completed survey Part 1, participants in negative polarity group completed survey Part 2. They were two independent and parallel survey parts, but the results of these two parts were very similar, which is worth mentioning.

The results of positive and negative displayed icons of both “Camera” and “Message” were almost the same. For both positive-display-polarity and negative-display-polarity icons, blue and green colors were the more preferred, and orange and yellow were the less preferred (Figure 4.7 (a) and (d)). As shown in Figure 4.7, for “Browser” icon (c), participants preferred blue and green colors when they saw both of the positive-display-polarity and negative-display-polarity

ones. And purple was the least preferred color for both of these two display-styled icons.

Participants' less preferred colors were orange and purple for both two display-styles, in terms of "Phone Call" icon (e). The most preferred color was green for both positive-display-polarity and negative-display-polarity "Phone Call" icon. It is noticeable that, icon color preferences were totally different for the two different display-styles, in terms of "Email" icons (b): When participants saw positive-display-polarity ones, they preferred green, red; but when they saw negative-display-polarity "Phone Call" icons, they preferred blue, yellow, and green.



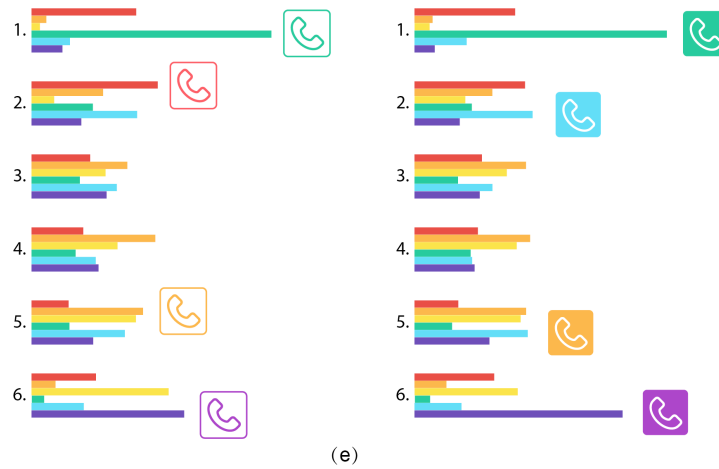
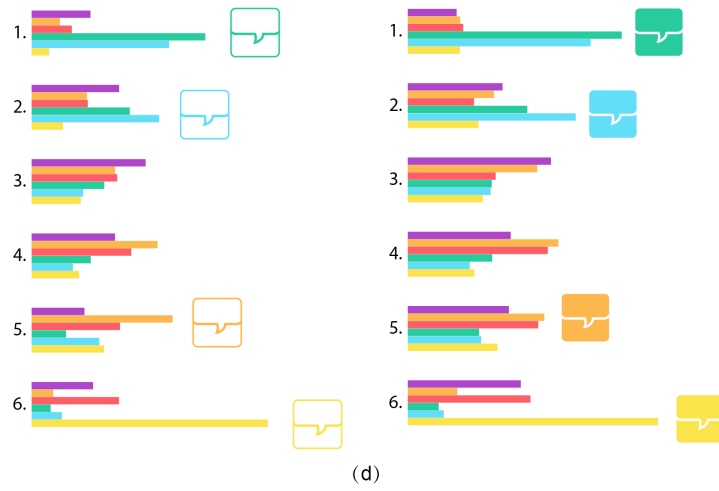
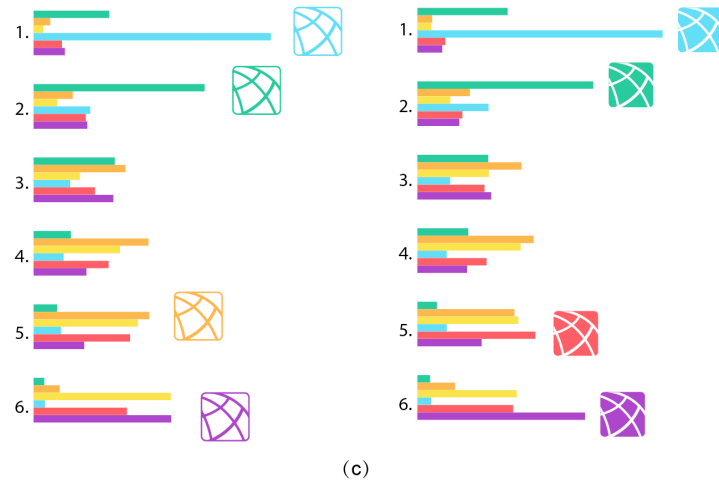


Figure 4.7 Comparison of positive and negative displayed icons' icon color preferences

b. Section 2: Preferences to positive and negative-display-polarity icons

Except Question 6 in Part 2, the other nine questions' results were similar—in nine of the total ten Section 2 questions, more participants preferred negative-display-polarity icons, no matter they saw positive-display-polarity or negative-display-polarity icons during the previous five questions.

c. Section 3: Individual color preferences

Individual's color preferences were similar for both positive polarity group and negative polarity group participants (Figure 4.8). It is obvious that, blue was generally preferred, and yellow was the least preferred by participants of both groups.

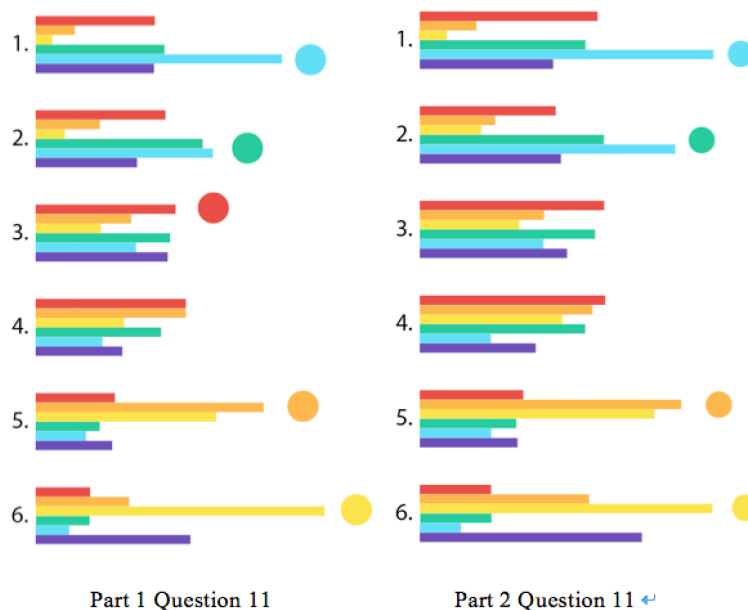


Figure 4.8 Comparison of individual color preferences of two participants groups

4.2.4 Pearson Correlation Tests

4.2.4.1 How color preferences of individuals affect users' icon color preferences













In order to test how individual color preferences affected icon color preferences, Pearson correlation tests were conducted with individual color preferences and icon color preferences as variables. The researcher conducted the tests for each color separately for both two survey parts. The results were interpreted at significance levels of 0.01 and 0.05 to test the significant effects.

The statistical results indicated the correlations between each color's individual color preferences and icon color preferences. Table 4.3 (red), Table 4.4 (orange), Table 4.5 (yellow), Table 4.6 (green), Table 4.7 (blue), and Table 4.8 (purple) were the statistical results for positive-display-polarity icons.

As shown in the Table 4.3 to Table 4.8, it is clear that there were significant positive correlations between all these six colors' individual color preferences and icon color preferences for positive-display-polarity icons. For example, as indicated in Table 4.3, all the correlations between red preferences and red icon preferences were significant, since all the Sig. (2-tailed) values were 0.000, which is smaller than 0.01. Additionally, all the correlations were positively related. It is clear that the correlations between red color and red "Camera" icon (0.338), red color and "Browser" icon (0.308) were medium positive correlations. The correlations between red color and red "Email" icon (0.294), red color and "Message" icon (0.287), red color and "Phone Call" icon (0.182) were low positive correlations. In another world, when people preferred red color, they tended to prefer red icons.













Therefore, the results inferred that the individual color preferences were related with icon color preferences. And the relationships between them were positive correlations.

Table 4.3. Correlations between red preferences and red icon preferences

		Correlations					
							
	Pearson Correlation	1	.149**	.253**	.179**	.111**	.338**
	Sig. (2-tailed)		.000	.000	.000	.001	.000
	N	1010	967	942	920	905	899
	Pearson Correlation	.149**	1	.175**	.218**	.113**	.294**
	Sig. (2-tailed)	.000		.000	.000	.001	.000
	N	967	967	942	920	905	899
	Pearson Correlation	.253**	.175**	1	.303**	.169**	.308**
	Sig. (2-tailed)	.000	.000		.000	.000	.000
	N	942	942	942	920	905	899
	Pearson Correlation	.179**	.218**	.303**	1	.211**	.287**
	Sig. (2-tailed)	.000	.000	.000		.000	.000
	N	920	920	920	920	905	899
	Pearson Correlation	.111**	.113**	.169**	.211**	1	.182**
	Sig. (2-tailed)	.001	.001	.000	.000		.000
	N	905	905	905	905	905	899
	Pearson Correlation	.338**	.294**	.308**	.287**	.182**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
	N	899	899	899	899	899	899













**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.4. Correlations between orange preferences and orange icon preferences

		Correlations					
							
	Pearson Correlation	1	.205**	.197**	.212**	.164**	.356**
	Sig. (2-tailed)		.000	.000	.000	.000	.000
	N	1010	967	942	920	905	899
	Pearson Correlation	.205**	1	.155**	.199**	.165**	.197**
	Sig. (2-tailed)	.000		.000	.000	.000	.000
	N	967	967	942	920	905	899
	Pearson Correlation	.197**	.155**	1	.267**	.316**	.245**
	Sig. (2-tailed)	.000	.000		.000	.000	.000
	N	942	942	942	920	905	899
	Pearson Correlation	.212**	.199**	.267**	1	.280**	.283**
	Sig. (2-tailed)	.000	.000	.000		.000	.000
	N	920	920	920	920	905	899
	Pearson Correlation	.164**	.165**	.316**	.280**	1	.189**
	Sig. (2-tailed)	.000	.000	.000	.000		.000
	N	905	905	905	905	905	899
	Pearson Correlation	.356**	.197**	.245**	.283**	.189**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
	N	899	899	899	899	899	899













**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.5. *Correlations between yellow preferences and yellow icon preferences*

		Correlations					
							
	Pearson Correlation	1	.363**	.341**	.233**	.287**	.414**
	Sig. (2-tailed)		.000	.000	.000	.000	.000
	N	1010	967	942	920	905	899
	Pearson Correlation	.363**	1	.281**	.265**	.312**	.316**
	Sig. (2-tailed)	.000		.000	.000	.000	.000
	N	967	967	942	920	905	899
	Pearson Correlation	.341**	.281**	1	.212**	.355**	.337**
	Sig. (2-tailed)	.000	.000		.000	.000	.000
	N	942	942	942	920	905	899
	Pearson Correlation	.233**	.265**	.212**	1	.260**	.241**
	Sig. (2-tailed)	.000	.000	.000		.000	.000
	N	920	920	920	920	905	899
	Pearson Correlation	.287**	.312**	.355**	.260**	1	.277**
	Sig. (2-tailed)	.000	.000	.000	.000		.000
	N	905	905	905	905	905	899
	Pearson Correlation	.414**	.316**	.337**	.241**	.277**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
	N	899	899	899	899	899	899

** . Correlation is significant at the 0.01 level (2-tailed).













Table 4.6. *Correlations between green preferences and green icon preferences*

		Correlations					
							
	Pearson Correlation	1	.278**	.180**	.099**	.072*	.396**
	Sig. (2-tailed)		.000	.000	.003	.030	.000
	N	1010	967	942	920	905	899
	Pearson Correlation	.278**	1	.203**	.124**	.054	.225**
	Sig. (2-tailed)	.000		.000	.000	.107	.000
	N	967	967	942	920	905	899
	Pearson Correlation	.180**	.203**	1	.108**	.089**	.216**
	Sig. (2-tailed)	.000	.000		.001	.008	.000
	N	942	942	942	920	905	899
	Pearson Correlation	.099**	.124**	.108**	1	.304**	.204**
	Sig. (2-tailed)	.003	.000	.001		.000	.000
	N	920	920	920	920	905	899
	Pearson Correlation	.072*	.054	.089**	.304**	1	.140**
	Sig. (2-tailed)	.030	.107	.008	.000		.000
	N	905	905	905	905	905	899
	Pearson Correlation	.396**	.225**	.216**	.204**	.140**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
	N	899	899	899	899	899	899

** . Correlation is significant at the 0.01 level (2-tailed).













* . Correlation is significant at the 0.05 level (2-tailed).

Table 4.7. Correlations between blue preferences and blue icon preferences

		Correlations					
							
	Pearson Correlation	1	.211**	.211**	.204**	.157**	.396**
	Sig. (2-tailed)		.000	.000	.000	.000	.000
	N	1010	967	942	920	905	899
	Pearson Correlation	.211**	1	.195**	.228**	.182**	.272**
	Sig. (2-tailed)	.000		.000	.000	.000	.000
	N	967	967	942	920	905	899
	Pearson Correlation	.211**	.195**	1	.261**	.180**	.252**
	Sig. (2-tailed)	.000	.000		.000	.000	.000
	N	942	942	942	920	905	899
	Pearson Correlation	.204**	.228**	.261**	1	.252**	.274**
	Sig. (2-tailed)	.000	.000	.000		.000	.000
	N	920	920	920	920	905	899
	Pearson Correlation	.157**	.182**	.180**	.252**	1	.204**
	Sig. (2-tailed)	.000	.000	.000	.000		.000
	N	905	905	905	905	905	899
	Pearson Correlation	.396**	.272**	.252**	.274**	.204**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
	N	899	899	899	899	899	899

** . Correlation is significant at the 0.01 level (2-tailed).

Table 4.8. Correlations between blue preferences and blue icon preferences

		Correlations					
							
	Pearson Correlation	1	.382**	.294**	.249**	.274**	.466**
	Sig. (2-tailed)		.000	.000	.000	.000	.000
	N	1010	967	942	920	905	899
	Pearson Correlation	.382**	1	.307**	.375**	.352**	.345**
	Sig. (2-tailed)	.000		.000	.000	.000	.000
	N	967	967	942	920	905	899
	Pearson Correlation	.294**	.307**	1	.261**	.337**	.249**
	Sig. (2-tailed)	.000	.000		.000	.000	.000
	N	942	942	942	920	905	899
	Pearson Correlation	.249**	.375**	.261**	1	.292**	.257**
	Sig. (2-tailed)	.000	.000	.000		.000	.000
	N	920	920	920	920	905	899
	Pearson Correlation	.274**	.352**	.337**	.292**	1	.281**
	Sig. (2-tailed)	.000	.000	.000	.000		.000
	N	905	905	905	905	905	899
	Pearson Correlation	.466**	.345**	.249**	.257**	.281**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
	N	899	899	899	899	899	899

** . Correlation is significant at the 0.01 level (2-tailed).

4.3 Summary

This chapter described the results of several data analyzes aiming to answer the study questions. To answer how users prefer icon colors?. Question 1 to Question 5 of both survey Part 1 and Part 2 were collected and analyzed. The results indicated that blue, green, and red were the more preferred icon colors, and purple, orange, and yellow were the less preferred icon colors. The interaction between icon meaning and icon color preferences was not significant.

Whether participants prefer positive-display-polarity or negative-display-polarity icons was also answered by analyzing the Section 2 data of both two survey parts. For nine of the total ten Section 2 questions, more participants preferred negative-display-polarity icons. In only one question (“Camera” icon) of Part 2, slightly more participants reported themselves preferred positive-display-polarity “Camera” icons.

Pearson Correlation tests were conducted to test how individual color preferences related with icon color preferences. The statistics results indicated that there were positive correlations between individual color preferences and icon color preferences.

CHAPTER 5. CONCLUSIONS

Icon is one important part of UX to express information on the surface of the whole UX system. When users use a product, the aesthetics quality of icons, including the colors of icons, significantly affects users' emotional responses. Since good emotional responses and experiences can attract new users and improve user loyalty, this study focused on users icon color preferences. The object of this study was to investigate how users prefer icon colors; will users prefer positive-display-polarity or negative-display-polarity, and how color preferences of individuals affect users' icon color preferences. The study results answered these three questions. According to the results of Question 1 to Question 5 in both parts, blue, green, and red were the more preferred icon colors, and purple, orange, and yellow were the less preferred icon colors. The different meanings of icons did not affect participants' icon color preferences significantly in both survey parts. Question 6 to Question 10 results indicated that more participants preferred negative-display-polarity icons. And the last question in both parts shown that participants preferred blue, green, and red colors. This results keeps consistent with Horton's statements: western adults prefer colors in order of: blue, red, green, purple, orange, and yellow" (Horton, 1994. P170). And statistics results indicated there were positive correlations between individual color preferences and icon color preferences.

Practical Contributions

The results of this study suggested several practical applications for designers:

1. Design negative-display-polarity icon, which is more widely preferred by users.
2. Use more widely preferred and acceptable colors (like blue, green, and red) in icon, since individual color preferences affect icon color preferences significantly, which will influence user experience with this product.

Limitations and Future Directions

This study had some limitations. The first limitation was that this study's participants were native American students. There was an absence of participants with more diverse nationality backgrounds. The second one was that this study only investigated six colors, which cannot stand for wider color scales. The third one was that in this study, the context, like background color, of the icons was not taken into consideration. Therefore, the future studies should examine more color combinations in more different contexts with more participants from different cultures.

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APPENDIX A. INSTITUTIONAL REVIEW BOARD APPROVAL

IOWA STATE UNIVERSITY
 OF SCIENCE AND TECHNOLOGY

 Institutional Review Board
 Office for Responsible Research
 Vice President for Research
 1138 Pearson Hall
 Ames, Iowa 50011-2207
 515-294-4566
 FAX 515-294-4267

Date: 1/6/2016

To: Qing Guo
 3224 Memorial Union

CC: Dr. Sunghyun Kang
 282 Design

From: Office for Responsible Research

Title: Icon Recognition

IRB ID: 15-751

Study Review Date: 1/6/2016

The project referenced above has been declared exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b) because it meets the following federal requirements for exemption:

- (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey or interview procedures with adults or observation of public behavior where
 - Information obtained is recorded in such a manner that human subjects cannot be identified directly or through identifiers linked to the subjects; or
 - Any disclosure of the human subjects' responses outside the research could not reasonably place the subject at risk of criminal or civil liability or be damaging to their financial standing, employability, or reputation.

The determination of exemption means that:

- **You do not need to submit an application for annual continuing review.**
- **You must carry out the research as described in the IRB application.** Review by IRB staff is required prior to implementing modifications that may change the exempt status of the research. In general, review is required for any modifications to the research procedures (e.g., method of data collection, nature or scope of information to be collected, changes in confidentiality measures, etc.), modifications that result in the inclusion of participants from vulnerable populations, and/or any change that may increase the risk or discomfort to participants. Changes to key personnel must also be approved. The purpose of review is to determine if the project still meets the federal criteria for exemption.

Non-exempt research is subject to many regulatory requirements that must be addressed prior to implementation of the study. Conducting non-exempt research without IRB review and approval may constitute non-compliance with federal regulations and/or academic misconduct according to ISU policy.

Detailed information about requirements for submission of modifications can be found on the Exempt Study Modification Form. A Personnel Change Form may be submitted when the only modification involves changes in study staff. If it is determined that exemption is no longer warranted, then an Application for Approval of Research Involving Humans Form will need to be submitted and approved before proceeding with data collection.

Please note that you must submit all research involving human participants for review. **Only the IRB or designees may make the determination of exemption**, even if you conduct a study in the future that is exactly like this study.

Please be aware that **approval from other entities may also be needed**. For example, access to data from private records (e.g. student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **An IRB determination of exemption in no way implies or guarantees that permission from these other entities will be granted.**

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

APPENDIX B. INFORMED CONSENT

Informed Consent

Title of Study: Icon Color Preference Online Survey

Participants: Faculty Supervisor: Sunghyun Kang, BFA, MA, MFA

Principal Investigator: Qing Guo, MFA, MS candidate

Introduction

You are invited to take part in an icon color preference online survey. All participants should be older than 18 years old. If you are under 18 years old, please skip this survey. The purpose of this survey is to find out smartphone users' icon colors preferences.

There are 6 ranking questions and 5 single choice questions in total. Most people can finish this survey in 5 minutes. Your responses will be confidential and you are free to quit the survey when you do not feel comfortable answering. Your responses will be of great use in furthering my research and in improving our understanding of the icon colors. Thank you in advance for your time and participation.

Benefits

There is no direct benefit to the participant. But, I hope to find out how users like different icon colors on smartphone interfaces. The results of this study will be used for scholarly purposes only.

Risks

There are no foreseeable risks in this study. However, you may leave the study at any time without penalty.

Participant Rights

Your participation in this study is completely voluntary and you may quit the survey at any time. If you decide to not participate in the survey, it will not result in any penalty or loss of benefits to which you are otherwise entitled. During the testing, if you feel uncomfortable at any time you can quit.

Confidentiality

All participants' data will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, federal government regulatory agencies and the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy your data for quality assurance and data analysis. These data may contain private information.

To ensure confidentiality to the extent permitted by law, the following measures will be taken.

Only the researcher will have access to the data. The data will be entered and kept in a password-protected computer located on the researcher's computer. Once the study has been concluded, all data files may be retained for future use pertaining to this research (process).

Questions or Problems

For further information about the study contact Qing Guo, Principal Investigator, qingg@iastate.edu.

If you have any questions about the rights of research subjects or research-related injury, please contact IRB Administrator, (515) 294-4566, IRB@iastate.edu, or Director, Office for Responsible Research, (515) 294-3115, 1138 Pearson Hall, Ames, IA 50011.

Agree Disagree

APPENDIX C. SURVEY RECRUITING EMAIL

Introduction script for part 1:

Hello,

You are invited to take part in an icon preference online survey. The purpose of this survey is to find out the smartphone users' icon color preferences.

This survey, which contains 11 questions, will be completed through online and will take less than 5 minutes to finish. As a participant, you will be asked to answer the questions.

If you would like to have any additional details about this research study, please contact Qing Guo via email: qingg@iastate.edu

You may start the survey at any https://iastate.qualtrics.com/SE/?SID=SV_6RpwfcrNqMlcWeV

If you are under 18 years old, please skip this survey.

Thank you so much.

We look forward to having you join the study.

Qing Guo

MFA Graphic Design candidate

Iowa State University

qingg@iastate.edu

Introduction script for part 2:

Hello,

You are invited to take part in an icon preference online survey. The purpose of this survey is to find out the smartphone users' icon color preferences.

This survey, which contains 11 questions, will be completed through online and will take less than 5 minutes to finish. As a participant, you will be asked to answer the questions.

If you would like to have any additional details about this research study, please contact Qing Guo via email: qingg@iastate.edu

You may start the survey at any
time: https://iastate.qualtrics.com/SE/?SID=SV_djbCmVFJkfEPdIh

If you are under 18 years old, please skip this survey.

Thank you so much.

We look forward to having you join the study.

Qing Guo

MFA Graphic Design candidate

Iowa State University

qingg@iastate.edu

APPENDIX D. SURVEY QUESTIONS (PART 1)

1. Please indicate your age at:

☐ 18 - 24☐ 25 - 34☐ 35 - 44☐ 45 - 54☐ 55 - 64☐ 65 - 74☐ 75 and
older

2. What's your gender?

☐ Male☐ Female☐ I don't want to indicate.

3. You are currently a _____ in ISU.

☐ Graduate student☐ Undergraduate student

4. What's your first language?

☐ English☐ Other. Please specify language:[>>](#)

Q1/Q11. Drag and drop to rank. Please rank each icon **color's APPROPRIATENESS** for the "Camera" icon on smartphone interfaces.

(Most appropriate COLOR at the top)



Q2/Q11. Drag and drop to rank. Please rank each icon **color's APPROPRIATENESS** for the "Email" icon on smartphone interfaces.

(Most appropriate COLOR at the top)



Q3/Q11. Drag and drop to rank. Please rank each icon **color's APPROPRIATENESS** for the "Browser" icon on smartphone interfaces.

(Most appropriate COLOR at the top)



Q4/Q11. Drag and drop to rank. Please rank each icon **color's APPROPRIATENESS** for the "Message" icon on smartphone interfaces.

(Most appropriate COLOR at the top)



Q5/Q11. Drag and drop to rank. Please rank each icon **color's APPROPRIATENESS** for the "Phone Call" icon on smartphone interfaces.

(Most appropriate COLOR at the top)




Q6/Q11. Please select which of the following icon **STYLES** do you **prefer** for "Camera" icon ?



>>

Q7/Q11. Please select which of the following icon **STYLES** do you **prefer** for "Message" icon?





>>

Q8/Q11. Please select which of the following icon **STYLES** do you **prefer** for "Browser" icon?





>>

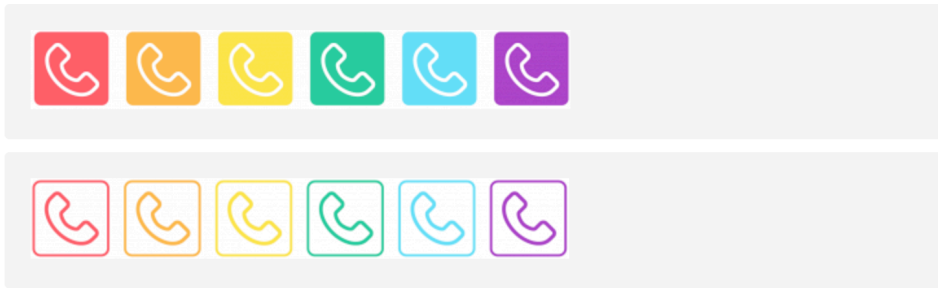
Q9/Q11. Please select which of the following icon **STYLES** do you **prefer** for "Email" icon?





>>

Q10/Q11. Please select which of the following icon **STYLES** do you **prefer** for "Phone Call" icon?



The image shows two rows of six phone call icons each. The top row features solid-colored icons: red, orange, yellow, green, light blue, and purple. The bottom row features outlined icons of the same color sequence. Each icon is a white telephone handset inside a square frame.



Q11/Q11. Drag and drop to rank. Please rank your **COLOR PREFERENCES**.

(Most preferred COLOR at the top)



APPENDIX E. SURVEY QUESTIONS (PART 2)

1. Please indicate your age at:

☐ 18 - 24☐ 25 - 34☐ 35 - 44☐ 45 - 54☐ 55 - 64☐ 65 - 74☐ 75 and
older

2. What's your gender?

☐ Male☐ Female☐ I don't want to indicate.

3. You are currently a _____ in ISU.

☐ Graduate student☐ Undergraduate student

4. What's your first language?

☐ English☐ Other. Please specify language:[>>](#)

Q1/Q11. Drag and drop to rank. Please rank each icon **color's APPROPRIATENESS** for the "Camera" icon on smartphone interfaces.

(Most appropriate COLOR at the top)



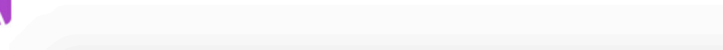
Q2/Q11. Drag and drop to rank. Please rank each icon **color's APPROPRIATENESS** for the "Email" icon on smartphone interfaces.

(Most appropriate COLOR at the top)



Q3/Q11. Drag and drop to rank. Please rank each icon **color's APPROPRIATENESS** for the "Browser" icon on smartphone interfaces.

(Most appropriate COLOR at the top)



Q4/Q11. Drag and drop to rank. Please rank each icon **color's APPROPRIATENESS** for the "Message" icon on smartphone interfaces.

(Most appropriate COLOR at the top)















Q5/Q11. Drag and drop to rank. Please rank each icon **color's APPROPRIATENESS** for the "Phone Call" icon on smartphone interfaces.

(Most appropriate COLOR at the top)









Q6/Q11. Please select which of the following icon **STYLES** do you **prefer** for "Camera" icon ?











>>

Q7/Q11. Please select which of the following icon **STYLES** do you **prefer** for "Message" icon?





>>

Q8/Q11. Please select which of the following icon **STYLES** do you **prefer** for "Browser" icon?



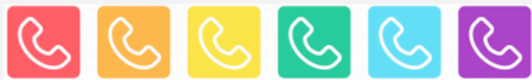
>>

Q9/Q11. Please select which of the following icon **STYLES** do you **prefer** for "Email" icon?



>>

Q10/Q11. Please select which of the following icon **STYLES** do you **prefer** for "Phone Call" icon?



>>

Q11/Q11. Drag and drop to rank. Please rank your **COLOR PREFERENCES**.
(Most preferred COLOR at the top)



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